Batrachoides cryptocentrus, Cuv. & Val.

Depth of body $4\frac{3}{4}$ to $5\frac{1}{2}$ in the length, length of head 3 to $3\frac{1}{4}$, width of head between opercles $3\frac{1}{2}$ to $3\frac{3}{4}$. Diameter of eye 5 to 6 in length of head, equal to or slightly less than interorbital width. One subopercular and two opercular spines. Maxillary extending beyond eye. Lower jaw a little projecting. Teeth on vomer and palatines large, uniserial, obtusely conical; 4 on vomer, 10 to 13 on each palatine; lower jaw with a single series of similar teeth, and anteriorly a patch of sharper teeth; premaxillaries with two rows of villiform teeth. Head and body entirely naked; head covered with small filaments, that above the eye well developed. Snout with a fringe of filaments; another fringe on lower jaw, four of which are distinctly larger than the remainder. From above and below base of pectoral two rows of open pores, appearing as white spots, which become indistinct in the adult, extend backward nearly to end of soft dorsal and anal respectively. Dorsal III 26–28; spines short, almost entirely hidden under the skin. Anal 22. Pectoral 21; a pigmented patch in the axil, but no foramen. Caudal 13, rounded. Brownish, paler below, with traces of darker vertical bands, disappearing in the adult; fins edged with darker. In young and half-grown individuals the throat is marbled with pale irregular spots.

Three specimens, 70–220 mm. in total length.

LXI.—*Note on the Forward Progression in its Shell of the Animal of the Nautiloidea and Ammonoidea.* Compiled from Notes left by the late G. C. Crick, F.G.S., by B. B. Woodward, F.L.S.

The three facts which are necessary to remember when attempting to form a conception of the mode of growth in the Nautiloidea and Ammonoidea are :—

(1) Growth in bulk of the animal taking place at regular intervals, terminated respectively by the formation of a new septum.
(2) Rigidity of the shell, necessitating a forward movement of the too bulky animal.
(3) Faculty of secreting gas, which must not be allowed to escape from the chambers of the shell.

It has been suggested that the formation of successive septa in the shells of these animals is correlated with the recurrence of reproductive periods; but Dr. Wiley * states definitely that this is not the case in *Nautilus*, since propagation, according to his observations, only takes place after the last septum has been formed (p. 747).

Nautilus is an expert and a rapid swimmer, owing to the buoyancy given to the relatively large external shell by its series of air-chambers. These chambers are not individually air-tight, since they are perforated by the siphuncle, the walls of which are permeable †, but collectively they are rendered an air-tight and water-tight hydrostatic apparatus, owing to the fact that the animal itself completely closes up the entrance to the chambers in virtue of its adherence to the shell by the muscles and annulus (girdle of Owen).

The method of formation of the septa, Dr. Willey writes (p. 749), "is simple so far as the septum itself is concerned. What is not so easy to understand is the manner in which the animal glides bodily forwards in its shell, so as to leave a space behind it which is destined to become the new air-chamber. . . . (p. 750). Keferstein (1865) and Appellöf (1893) supposed that the mechanism of the forward movement of the muscles in the shell consisted of a resorption of muscular substance of the hinder border, coincident with a formation of fresh muscular substance in front. But this pretended resorption of muscle-fibres could not be confined to the ends of the muscles, where they abut upon the shell, but must affect the entire body of the muscles. There is no evidence whatever that anything of the kind takes place, since the muscles increase in size *pari passu* with the growth of the animal, and the presence of the concentric muscle-lines on the shell, visible as they are from the septal suture to the anterior border of the muscle-scar on each side, is clearly indicative of a very gradual forward gliding of the animal. As the animal grows it must of necessity move forwards within the rigid walls of the shell, since the increase in size takes place in every direction, quite as much in girth as in length. At the same time the soft visceral sac can accommodate itself to a certain extent to straightened circumstances, sufficiently to avoid any sudden catastrophic movement, and, meanwhile, gas is secreted by or through the thin *septal area* of the mantle, and when the limit of growth at any particular period is reached, a new system is laid down."

* Zool. Results, pt. vi. (1902), from which paper many of the following notes are taken.

† Brooks, Proc. Boston Soc. Nat. Hist. xxiii. 1888, p. 380.

The mode of progression of the Ammonite animal in its shells must, obviously, have been similar to that just described for *Nautilus*. In the case of an Ammonite with a comparatively simple septal suture, or when the anterior part of each lobe is relatively broad, the process presents but little difficulty; when, however, the septal suture is very complicated, and especially when the anterior part of each lobe is considerably contracted, the mode of progression of the animal in its shell at first sight presents some difficulty. An easy and satisfactory explanation is, however, possible. This explanation presupposes the attachment of the animal to its shell by means of shell-muscles and an annulus like the living *Nautilus* as described in a paper to the Linnean Society (Trans. Linn. Soc. ser. ii. (Zoology), vol. vii. pp. 71–113). The marks left by the anterior edge of the annulus (anterior aponeurotic band) on the inside of the shell indicate that the animal progressed forward at an even rate.

The digitations visible at the septal sutures when traced towards the centre of each septal surface rapidly die out and give place to a much more simply curved surface. During the formation of a septum the visceral hump of the animal was attached to the shell-wall, not only by the boundary of that part of the hump engaged in the formation of the septum, but also by the shell-muscles and the annulus, the forward growth of the animal in its shell being temporarily suspended. On the completion of the septum and the renewed onwards growth of the shell-muscles and annulus, room would be given to the animal to contract the posterior portion of the visceral hump inwards, and thus release and withdraw all the fine digitations of the mantle from the crumpled edge of the septum. When the creature had advanced sufficiently far forward in its shell, further progress was temporarily suspended, the mantle digitations were again pressed outwards against the shell-wall, and the next septum formed.

In some cases, when an adequate interval has not been attained, this results in the backward extensions (=lobes) being pressed upon the forward extensions (=saddles) of the preceding septal suture, so that the resultant successive septal-suture lines are crowded on each other to such an extent as to be difficult to follow out. Such a case is well shown in the figure given by Pervinquière of a specimen of *Mortoniceras proratum*, Coquand (Carte Geol. Tunisie.—Études Paléont. Tunisienne. I. Céphalopodes terr. Sécond. 1907, p. 238, fig. 97), and again (p. 298, fig. 114) in an example of *Acanthoceras aumalense*, Coquand. These cases are in all probability pathological.